

VII.—*Natural History Notes from H. M.'s Indian Marine Survey Steamer 'Investigator,' Commander ALFRED CARPENTER, R. N., D. S. O., Commanding. No. 9. Further Notes on the Amphipoda of Indian Waters.—By G. M. GILES, M. B., F. R. C. S., Surgeon-Naturalist to the Marine Survey.*

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(With Plates VI.—XII.)

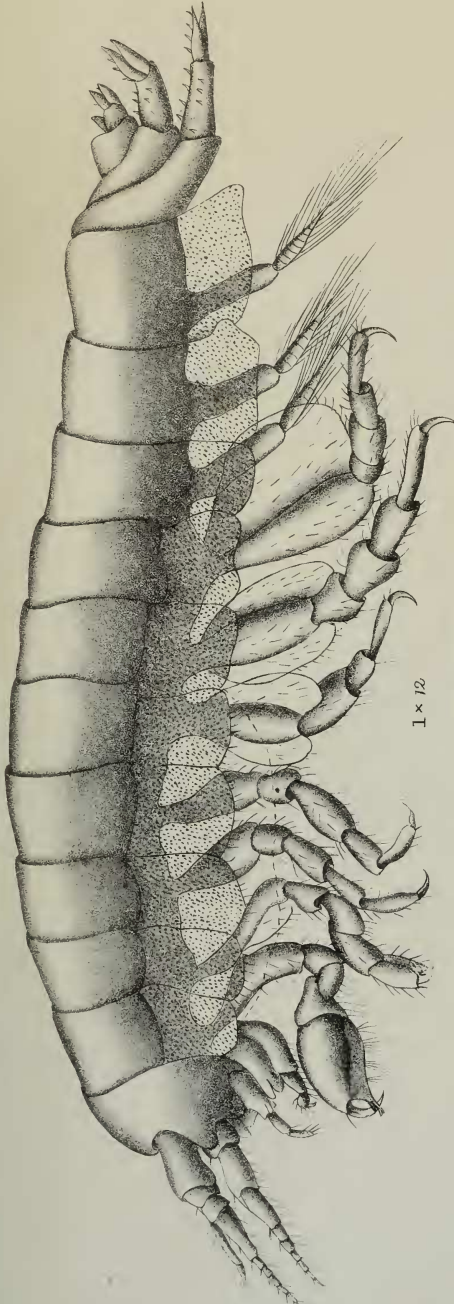
How little the Amphipoda of the Bay of Bengal have been hitherto worked may be judged from the fact that every species I have as yet examined appears to be new to science. Indeed, with the single exception of a fresh-water species, *Gammarus fluviatilis*, which I met with in a mountain lake (the Pandar) at an elevation of 11,000 feet in the Hindu-Kush range, and of the doubtful case of *Amphithoe indica*, M. Edw., described in the present paper, I have yet to find a described Indian form.

The group having been thus hitherto neglected in India, it appears a good plan to set about the description of the species as they come to hand, more especially as, on account of their minuteness and fragility, they are best examined in the living state, a work which can only be carried out on boardship.

On this account the species are described provisionally in the order in which they come to hand, the work of arranging them systematically being left to some future time when sufficient material shall have been collected. I will now proceed to describe the species met with since my last contribution to this Journal.

1. ANONYX AMAURUS, n. sp., Pl. VI., Fig. 1.

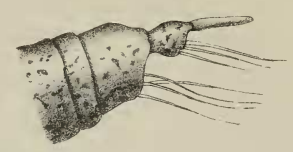
This form is interesting on account of its having, as far as I can make out, no traces whatever of eyes. It was trawled at a depth of 1300 fathoms off the Coast of Burmah in Lat.  $16^{\circ} 44' 45''$  N., Long.  $95^{\circ} 34' 30''$  E.; bottom temperature  $36^{\circ}$ . Although this station is over 40 miles from the nearest shore, the bottom appears to consist largely of water-logged drift wood, and other shore material, amongst which was a number of the fruits of a plant which, Dr. King of the Royal Botanical Garden, Calcutta, informs me, are probably those of *Baringtonia racemosa*. The abundant albuminous material of the seed is still comparatively fresh and sound. On breaking open one of these, I found two specimens of our species; and another seed yielded a third specimen. All three are females and the egg-pouches of two contained ova. The animal is, for an amphipod, remarkably broad in proportion to its depth, the pleura being narrow, while the coxal plates are of considerable depth.



1 x 12



2 x 24

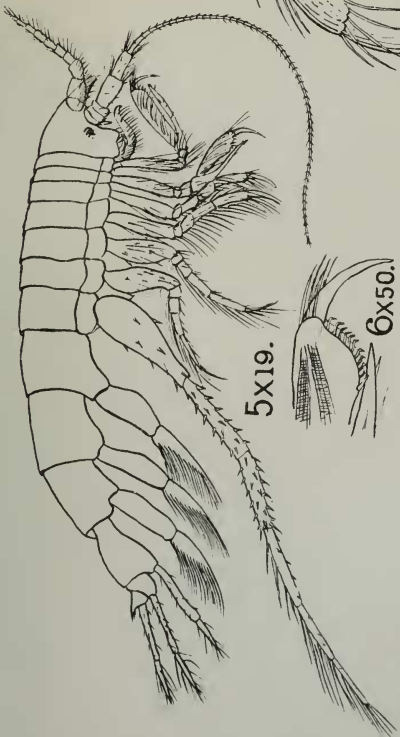


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4 x 100

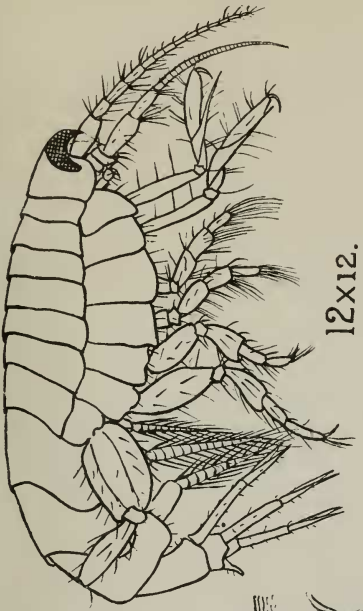




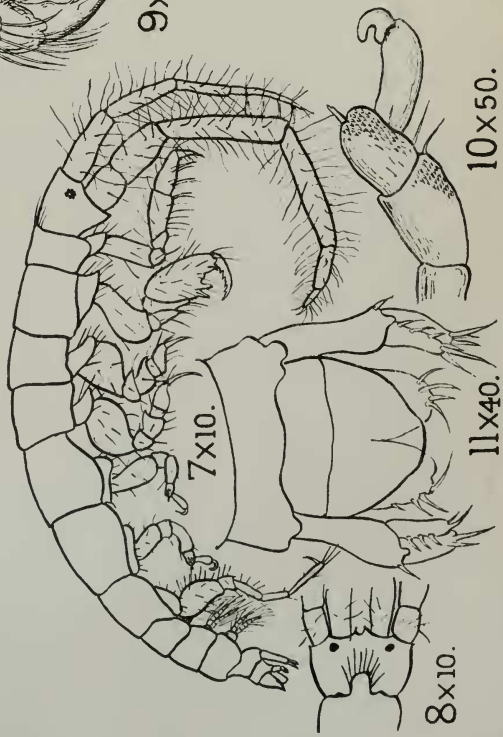
5x19.



6x50.



12x12.



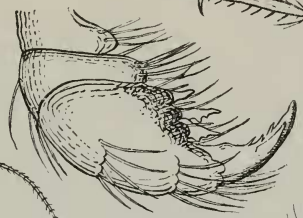
7x10.



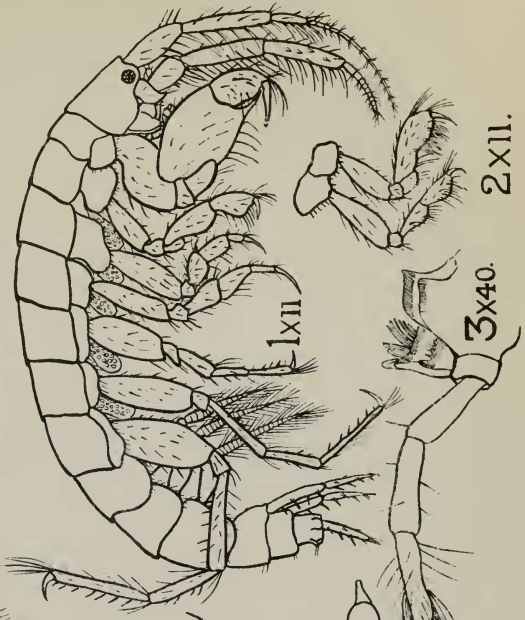
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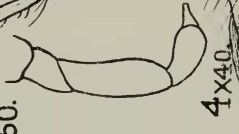
10x50.



9x50.



11x11.



4x40.

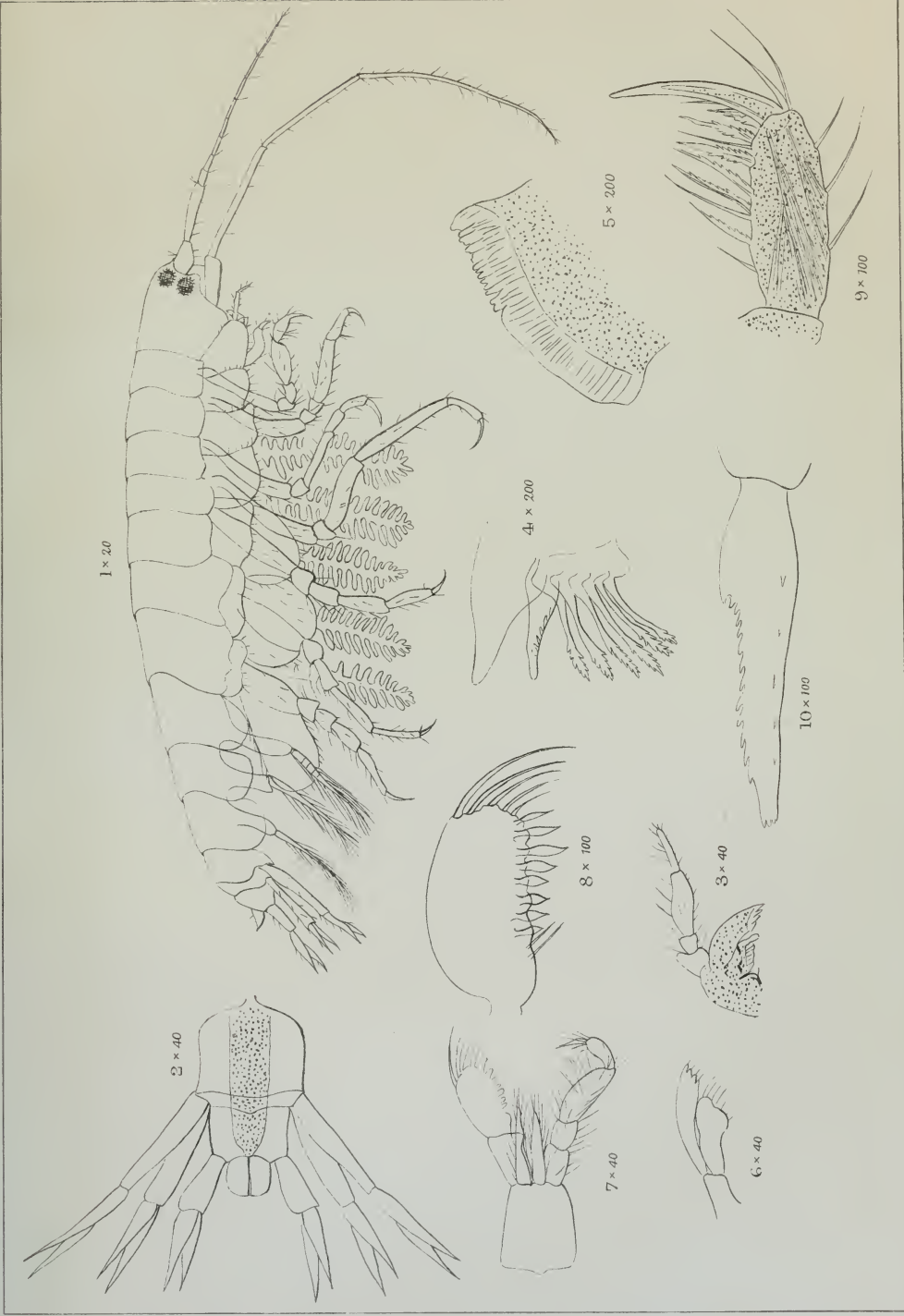


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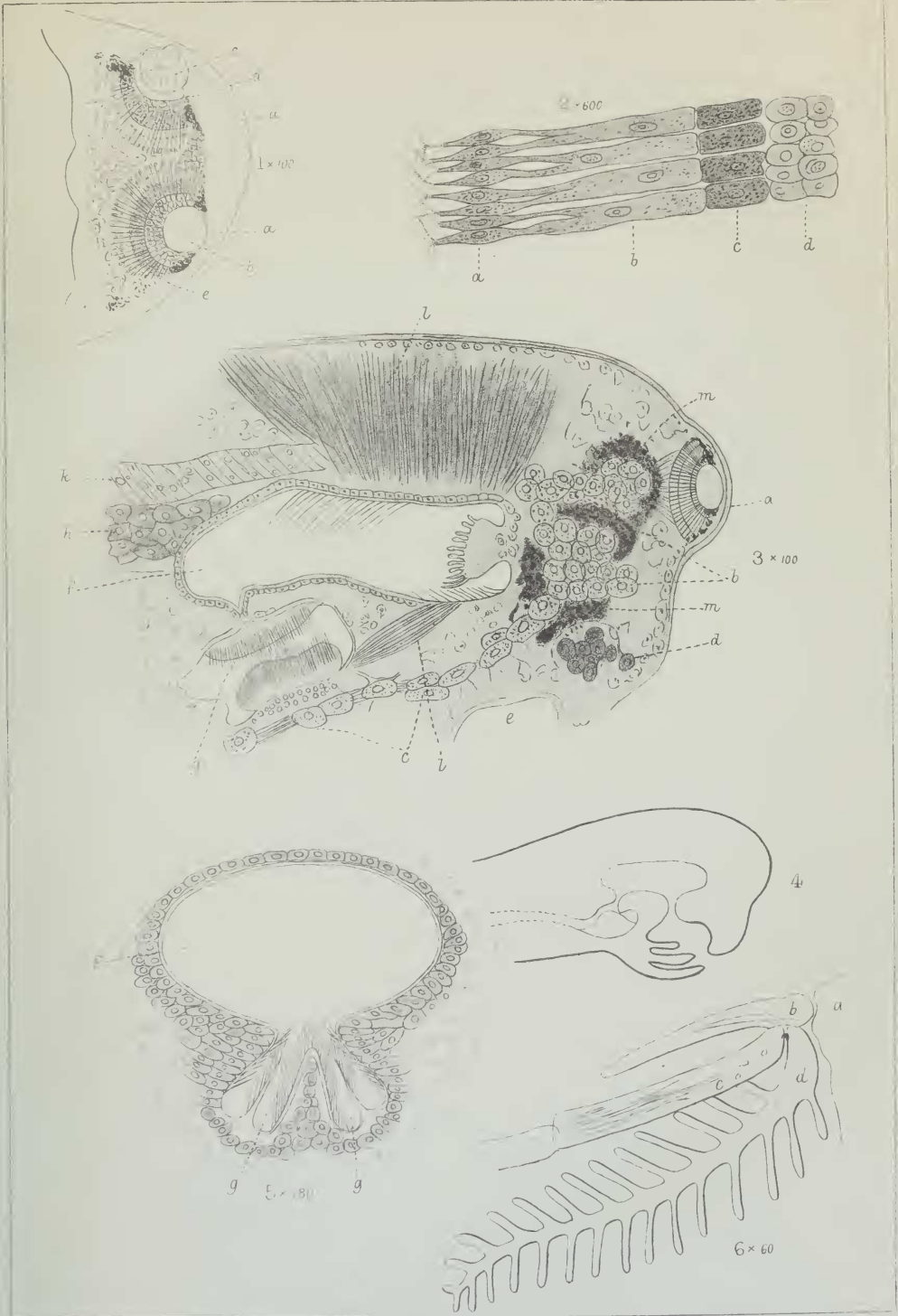


2x11.



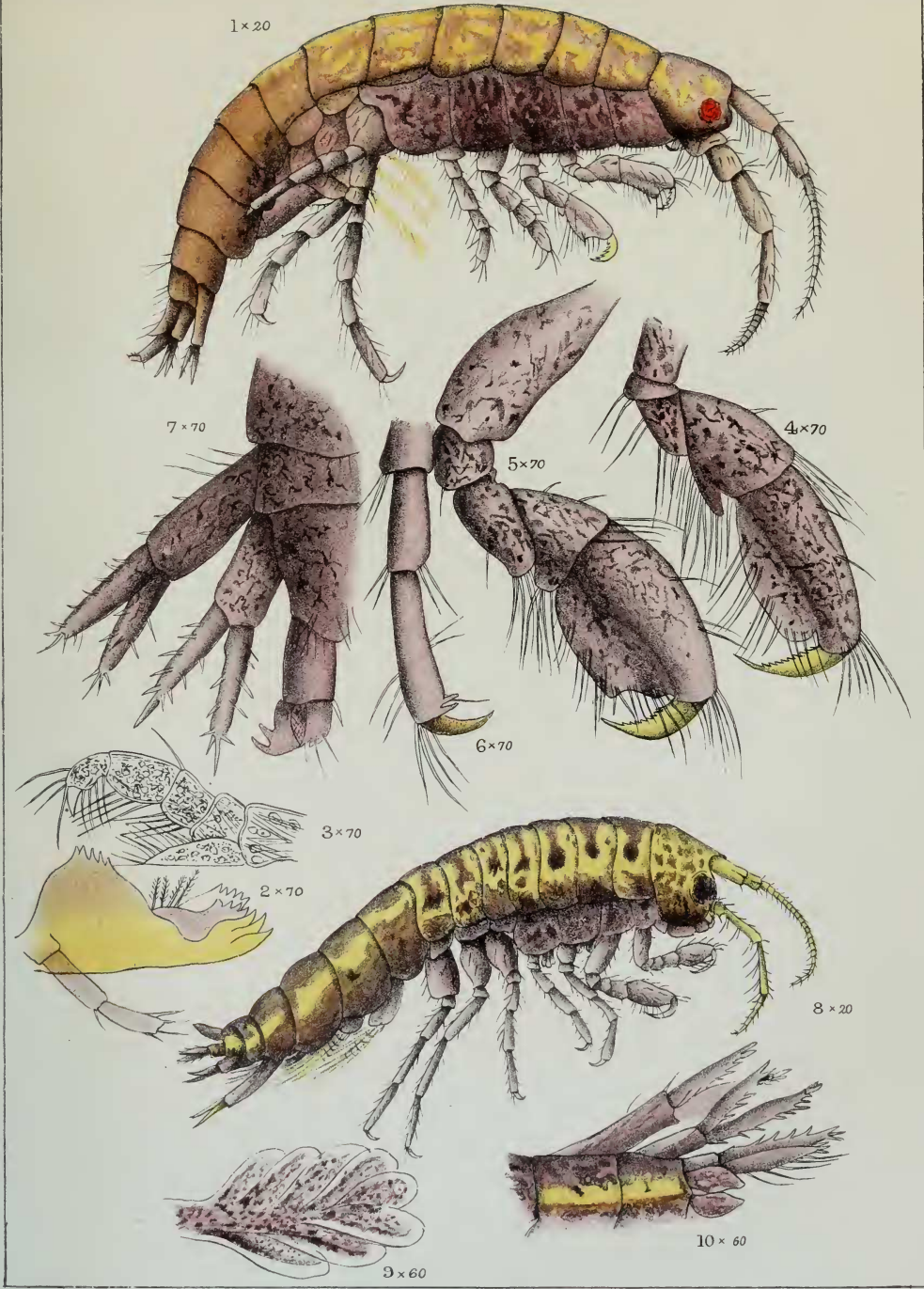












G. M. Giles, del.  
Parker & Coward, lith.

West, Newman & Co. imp.

1-7. AMPHITHOË INDICA. M. EDW.

8-10. ATYLUS COMES. n. sp.



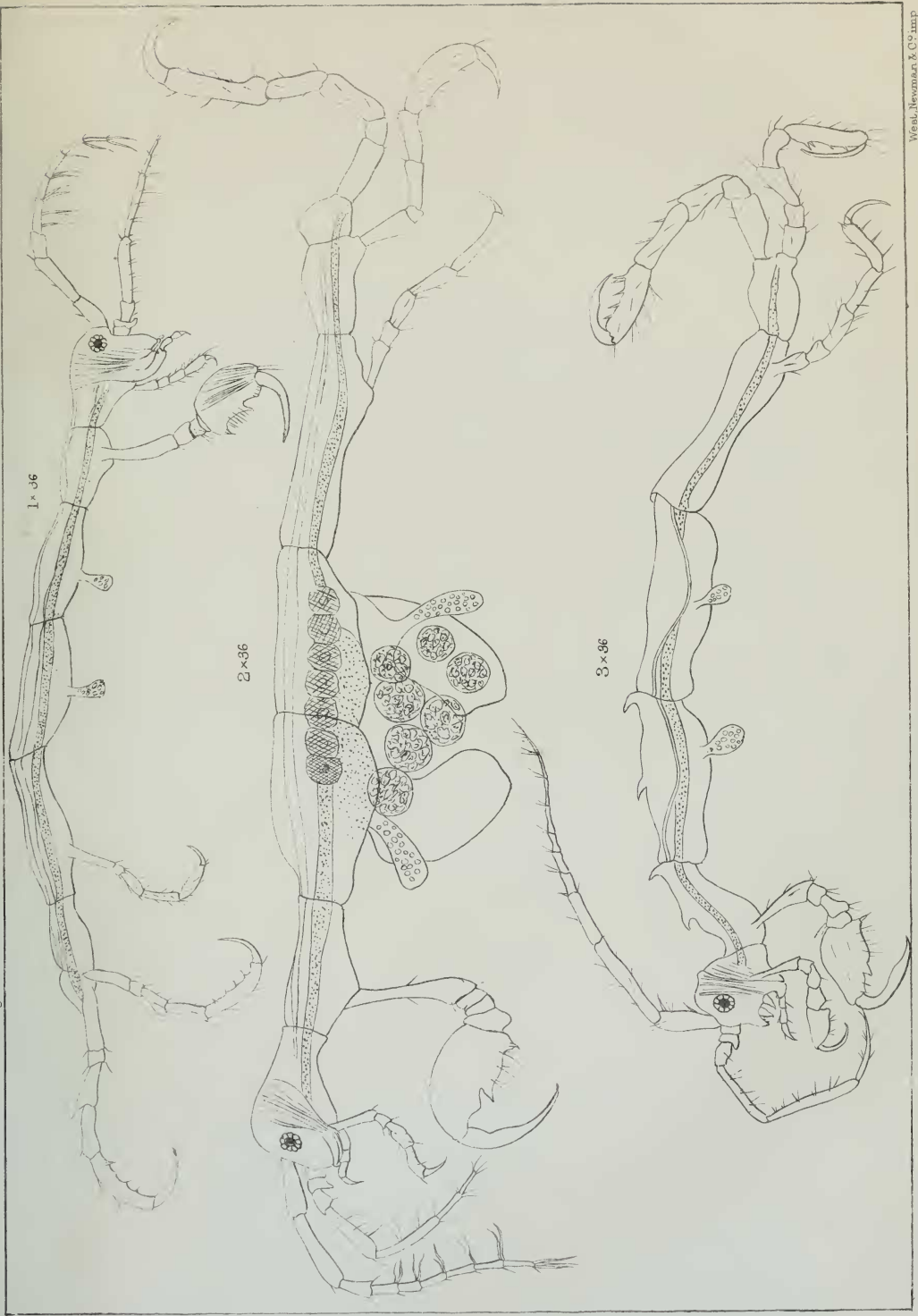


Parker & Rowland lith.

West, Newman & Co. amp.

UROTHOE RUBER.







The legs are short and stout and the mouth-parts exceptionally strong, so as to be eminently suited for digging its way into the hard albumen of the seeds on which it feeds. It might at first sight appear strange that an inhabitant of so great a depth should feed on such exclusively shore products. From the quantity of these seeds and other driftage brought up in the trawl, it is, however, evident that, as long as the tides and currents remain as they now are, the animal can never be at a loss for food. That it is really a bottom organism there can be no doubt, as, apart from its eyeless condition, its limbs are ill-suited for swimming, and the driftage brought up in the trawl was too abundant and of too varied a character to admit of any suspicion of its having been picked up by the trawl on its upward or downward route.

The species can, however, have but a very limited distribution, as situations in which abundant and well-preserved food drifted from the shore is to be found at such a considerable depth must be quite exceptional, and widely separated from each other, as they can only be found in the neighbourhood of great tidal rivers, and where such enter the sea in the neighbourhood of considerable depths.

The animal is of an uniform ivory-white throughout; and the largest specimen is about 12 mm. in length.

The *head* is small and short, rounded in front and broad behind at its junction with the thorax, where the animal very nearly attains its maximum breadth.

The segments of the *thorax* are long and subequal, the middle members of the series, however, slightly exceeding the others in all dimensions.

The first three *abdominal segments* are longer than any of the thoracic and of remarkable depth, the third being the largest. The remaining three segments diminish rapidly in size, and the *telson* is small, conical, and upturned.

The *antennule* is short and stout, its total length being but one-fifth that of the body. It consists of a peduncle of three joints, of which the first is long and cylindrical, and the remaining two, remarkably short, form considerably less than half of the peduncle. The flagellum consists of a long conical basal joint, forming quite half its length, and of five or six short tapering joints of the usual form. The secondary appendage consists of two joints, the first of which, though much thinner and cylindrical, exactly equals the first joint of the primary flagellum in length, while the second joint is small and short.

The *antenna* is subequal to the antennule, but of slighter build. Its peduncle is longer, consisting of three joints of nearly equal length,



which together nearly equal the peduncle of the antennule with the long first joint of its flagellum in length. Its remaining joints if present cannot be distinguished. The flagellum consists of six or seven short joints.

The *gnathites* are remarkably short, the mandibles being especially powerful and provided with a long jointed appendage. The maxillipedes are large and pediform, and are terminated by a globular joint provided with a strong claw.

The second of the *thoracic appendages* is very stoutly built, and is terminated by a powerful subchela, the dactylopodite forming a powerful curved claw, and the propodite having its posterior border prolonged into a stout plate, which is curved downwards to oppose the dactylopodite; this plate is armed with a number of tooth-like spines not shewn in the drawing. The third thoracic appendage, in general form, closely resembles the second, but it is slightly longer, and very much slighter, and differs also in the basipodite being strengthened on its anterior border by a strong flat plate. The fourth and fifth thoracic appendages are somewhat shorter than the two preceding, stoutly made, and of the ordinary ambulatory type. The sixth, seventh, and eighth have their basipodites provided with large strengthening buttress-like plates; all three are stoutly built, but, while the sixth is the shortest, the seventh is the longest of all the appendages. The eighth is intermediate in length, but has its distal five joints shorter even than those of the sixth, its excess of length over the latter being due entirely to the great size of the basipodite, which is nearly twice as long as that of any other appendage; it has no strengthening plates on its anterior border, but this is more than compensated for by the immense size of the posterior buttress.

The first three *abdominal appendages* are of the usual swimming type, but are somewhat small in proportion to the bulk of the animal. The last three appendages are short and stout, and are each provided with a pair of short, subequal, styloid rami; they diminish progressively in length and to a less extent in thickness, the last being rather shorter than its breadth; all three are armed with a series of short stout spines.

The animal differs from any of its congeners enumerated in Spence Bate's Catalogue in the first joint of the flagellum and of the appendage of the antennule being markedly longer than their successors; in being eyeless; and in the exceptional development of the gnathopoda, which are much better formed even than in the closely allied *Opis*, a genus to which, if this character alone were taken into account, the species might be referred. The distinction, however, between *Anonyx* and *Opis*, resting as it does on this character alone, is of very doubtful generic value, and

I have preferred to class the present form under *Anonyx* on account of its more closely resembling in most other points the known species of that genus than it does the hitherto described species of *Opis*.

Since the date of the issue of Spence Bate's Catalogue of the Amphipods of the British Museum (1862), a considerable number of species have been added to *Anonyx* and a few to *Opis*, the descriptions of all of which are not accessible in India. From considerations of locality and depth, it is, however, highly improbable that any of these corresponds to the species now described.

Sars (Archiv Math. Naturv. (Christiania) 1881, p. 437) has described an eyeless species of the genus (*A. typhlops*) from 1710 fathoms in the Arctic seas, but I have not been able to obtain access to the paper. The temperature of the water at such depths as 1300 and 1710 fathoms is pretty constant all over the world, and deep-sea species have, as a rule, a wide distribution, so that it is possible that our forms may be the same. Still it appears extremely unlikely that the present species would be able to obtain suitable food in such regions, so that, provisionally at any rate, I describe it as new in the absence of any evidence to the contrary.

## 2. AMPELISCA LEPTA, n. sp., Pls. VIII. & IX.

This species was dredged in 107 fathoms on the edge of the Swatch-of-no-Ground, at the head of the Bay of Bengal. A very large number of specimens were obtained in the mass of soft mud brought up in the dredge, which, with the exception of a few annelids, contained no other living organisms. The mud contained a quantity of broken lamellibranchs and pteropod shells, but none of these appeared to have been recently inhabited.

The subfamily *Ampeliscales* contains the single genus *Ampelisca*; *Haploops* wanting the character of having two pairs of simple eyes, and so being very doubtfully a member of this subfamily. With the characteristics of *Ampelisca*, as given by Spence Bate (Cat. Amphip. Crustacea, p. 90), the present species entirely agrees, but it differs from the five of the known species figured in that work in the slenderness of the body, and in the great length of the fifth thoracic appendage, and wants also the vinous colouration which appears more or less to characterize many of the species. These points, however, are hardly sufficient to be of generic value.

The animal measures about 6 mm. in length and is of a fine ivory white throughout, with the exception of the rings of dark brown pigment surrounding the eyes.

The head is of moderate size, irregularly quadrate; the portion carry-

ing the eyes and antennules projecting forwards much beyond that giving support to the antennæ. In length, it barely equals the first two thoracic segments together.

The two pairs of *eyes* are of fair size and are placed close to each other on the produced upper part of the cephalon, the outer pair being situated a little behind as well as below the inner.

The *thorax* consists of seven distinct segments increasing gradually in length from before backwards, the last being the longest. It forms exactly half of the total length of the animal. The first four coxal plates are deep and vertical, while the last three are narrow and much everted, giving a fictitious appearance of breadth to this portion of the body when seen from above.

The first of the *abdominal segments* is as long as the last thoracic, but the second and third are considerably shorter, while the remaining three are very short, the fifth being not half the width of either the fourth or sixth, and with difficulty distinguishable from the former. The *telson* forms a deeply cleft, semilunar plate, which appears to be movably articulated to the sixth segment.

The *antennæ* and *antennules* are long and slender, but unequal. The *antennules*, much the shorter, equal the first six thoracic segments in length. The peduncle consists of a short spindle-shaped basal joint and two slender distal articulations, of which the first is nearly four times as long as the second, which is with difficulty distinguishable from the flagellum. This latter consists of ten very slender articulations. The *antennæ* are as long as the body less the last four abdominal segments. The peduncle consists of five joints, of which the first two are very short, completely hidden behind the projecting anterior border of the cephalon. The third joint is long and thick and the fourth and fifth very long and slender, so that the flagellum forms much the shorter portion of the organ. This latter is but little longer than that of the antennule and consists of 14 or 15 slender somewhat shorter articulations.

The *gnathites* are rather small and are more adapted for sifting and retaining finely divided material than for biting and cutting. The mouth is guarded in front by a blunt triangular plate, which appears to be immovably connected with the anterior surface of the head. The mandibles are provided with a four-jointed hirsute appendage and with two plates, of which one has a simple cutting edge of no great power, perfectly smooth for its posterior half, but worn in front into a series of irregular dentations. The second plate has a more complex structure. In front it is provided with two stout conical teeth, the more anterior being quite plain and smooth, while the posterior, which is more slender and pointed, has its posterior border minute-

ly dentated. Behind these two teeth comes a plate immovably connected with that bearing them, but placed more to the dorsal aspect of the organ, and bearing six processes or stout hairs of peculiar form. Arising from stout bases they at first become constricted and then expand into a lanceolate terminal plate the borders of which are minutely dentated. It is difficult to determine what may be the function of these peculiar organs, unless it be to finely comminute the mud from which the animal separates the nutritive particles on which it subsists. The first maxillæ present no points of particular interest, consisting of the usual pair of hirsutely edged plates. The second maxillæ are somewhat peculiar, their inner border being armed with a series of peculiarly formed flattened hairs shaped like small lanceolate leaflets. The maxillipeds are four-jointed, pediform, and clawed, and are provided with a pair of elongated flattened inner plates, both these and the main portion of the organ being extremely hirsute.

The second and third *thoracic appendages* are but little modified from the plan ambulatory type, presenting only a tendency to the subchelate plan of construction, the dactylus being long and smooth, and the propodite being but little dilated; the only specialization for grasping being the provision of a series of stout dentate hairs on its posterior border, not unlike those on the mandibles. Both these pairs of appendages are essentially alike, but the third is considerably the longer and is even less specialized than the second, the propodite being barely dilated, and the dactylus, of very moderate strength. The fourth and fifth appendages are quite of the usual ambulatory type, and alike in general plan, but, while the first is the slightest and shortest of all the appendages except the second, the fourth is the longest and stoutest, slightly exceeding the thorax in length. The sixth and seventh are of moderate length, the sixth having its distal articulations exceptionally stout, while those of the seventh are exceptionally slight, both have their basipodites strengthened by anterior and posterior buttress-like plates; the eighth has the basipodite very stout and is strengthened behind only by an extremely broad plate, its breadth being one and a half times its length. The eighth appendage is short and its remaining articulations are in general form like those of the seventh.

The first three *abdominal appendages* are of the usual swimming type, but are more freely furnished with hairs than is usually the case. They diminish regularly in size from before backwards. The last three are biramous and styloid, armed only with a few short spines on their protopodites. The rami are somewhat flattened and have a bold hollow curve on their inner borders beset with minute dentations (Fig. 10.).

The animal differs from *A. gaimardii*, *A. ingens*, *A. belliana*, *A. limicola*, and *A. japonica*, the species figured by Spence Bate (*loc. cit.*), in the great length of the fifth thoracic appendage; from *A. pelagica* in the antennæ being shorter, in its colour being white instead of pale yellow, and in presenting no blotches of red pigment on the cephalon; from *A. macrocephala* in the eyes being larger, and the upper and lower pairs equally distinct, in none of the segments being carinate, in colour, and in size; from *A. tenuicornis*, *A. levigata*, and *A. carinata* in wanting the posterior dorsal carina.

ANATOMY.—The visual organs of *Ampelisca* are arranged in a manner somewhat exceptional amongst the *Amphipoda*. Being anxious to examine the minute structure of these and to make out whether both pairs of eyes were alike or of different structure, I made several sets of serial sections in the various axes of the animal. From an examination of these, the following points were made out, which, without pretending to be a complete account of the minute anatomy of the animal, it may be well to record.

*Organs of Vision.*—The two pairs of eyes are identical in structure, but quite distinct from each other, and belong to a high type of the simple invertebrate eye. The portion of the chitinous coat of the head which forms the "cornea" is but slightly more convex than the general curve of the part. Imbedded in this is a refractile body of a slightly flattened spherical form, consisting of a delicate sac containing a structureless gelatinous material.

The sac is quite distinct from the cavity in which it is contained, and is capable of dislocation from its hollow bed. In sections where this has happened the contained material may be seen oozing from the shrunken sac, and forming a drop very similar in appearance to the myelin drops that form in the course of a medullated vertebrate nerve. The lens, thus formed, rests on a concave surface formed of the epidermic layer of the head, which here consists of soft rounded cells, granular and easily stained in spirit specimens, but doubtless quite transparent in life. Surrounding the lens, and forming a sort of iris, is a ring of these epithelial cells, deeply impregnated with a deep brown pigment.

Behind this epithelial layer comes the retina. This consists of three distinct layers. Immediately beneath the epithelial layer is a layer of cylindrical bodies, nucleated and deeply pigmented, and continuous with the bases of these (so that each appears to have its continuation in the next layer) is a layer of tapering rods, which divide at their deeper extremity into two or more slender fibres. Between these two layers there is doubtless an organic connection, each cylinder fitting accurately on to its corresponding rod, but that the continuity is

not absolute is evidenced by the existence of a distinct line free from granules at their point of junction, and by the circumstance that rough handling has a tendency to separate the layers at this point. The rods, like the cylinders, are nucleated, the nuclei lying not all in the same plane, but exhibiting a tendency to alternation. These rods contain but few granules and, as already mentioned, divide below into a number of fibres, each of which is continuous with a cell of the third and last layer. This last layer consists of spindle-shaped cells strongly granular and distinctly nucleated. They are prolonged at their superficial extremities into fibres, which are continuous with the branches of the rods of the second layer, and their deep extremities split up into a number of fine fibres, which can, in favourable cases, be made out to inosculate with fibres issuing from the ganglionic mass supplying the eye.

With such refractile arrangements, the outer surface being but little curved, the entire work of refraction must be performed by the lenticular bag of highly refringent fluid, and the rays, passing through the transparent epidermic layer, must be brought to a focus on the deeply pigmented anterior extremities of the front layer of rods of the retina. The lens is probably a modified cuticular structure. It must be acknowledged that so specialized a structure as this is of a higher type than the very ill-developed compound eyes which are commonly met with amongst the *Gammaridae*.

*Nervous System.*—The ventral nerve cord is large and well developed. In the thoracic region, the paired ganglia are placed so close to each other as to nearly blend, the transverse commissures presenting scarce any constriction. In the abdominal region these commissures are somewhat longer. The longitudinal commissures between the second thoracic and the maxillipedal ganglia are longer than usual and diverge outwards, the latter pair being placed fully the width of the œsophagus apart. From these spring the long commissures of the œsophageal collar, which in front join with two long, cord-like chains of cells which lie on each side below the anterior prolongation of the peculiar gizzard to be described below. This ganglionic cord, curving upwards, blends with the main mass of the supra-œsophageal ganglion, which fills up nearly the entire space of the head between the gizzard and its anterior wall. From the periphery of this mass project eight rounded processes, the centres of the two pairs of eyes and of the two pairs of antennæ respectively. Those of the eyes lie almost in contact with the bases of the retinal spindle cells and distinct fibrous connections can be made out between them and the retina. From the long cord-like horns that run back from the main brain mass to the œsophageal commissure, branches may be traced to the gnathites and to the green-gland. Each of the great

ganglion masses, the ventral ganglia included, is surrounded more or less completely by a layer of small round cells that have all the histological characteristics of leucocytes. From an examination of certain figures illustrative of current researches in the group, I am inclined to think that these have been, in some cases, mistaken for nervous elements and described as portions of the ganglion system. They are, however, simple granular rounded cells with small indistinct nuclei, both cell substance and nuclei greedily absorbing all dye stuffs. These cells are quite without tails or other protoplasmic connections, and appear to be packed in the intercellular lymph tissues surrounding the ganglia rather than embedded in any intercellular material. They are certainly mesoblastic and probably are plasmic cells whose function it is to subserve the rapid nutritive changes going on within the ganglionic system.

*Muscular System.*—This, in one species, is but feebly developed, the sections contrasting strongly with those of species of more active habits, such as inhabit the surface. In the head a number of radially placed bands suspend the gizzard, those in the middle line above being the most strongly marked. A strong band runs between the anterior part of the under surface of the gizzard obliquely downwards and backwards to the antero-inferior corner of the “sifting” stomach. The body muscles are especially feeble, the best developed being the great extensors of the segments, which attain a development somewhat superior to the other body muscles. The great obliquely vertical bands which take up so large a share of the segmental space in most crustaceans are scarcely developed at all in the thoracic segments and but feebly so for even the first three abdominal segments, which usually have these muscles of immense size for keeping up the constant vibrations of the three anterior abdominal appendages. Living, however, as this species does, imbedded in tolerably thick mud, it can have but few opportunities for putting this movement in action, the want of a free current through its branchial plates being met in another way. The muscles of the thoracic appendages and of the last three abdominal appendages are correspondingly weak, the greater part of the space within the articulations being taken up with aggregations of plasmic cells like those already described as surrounding the ganglionic centres.

*Digestive System.*—The gnathites, already described, work beneath a vaulted space formed by the sterna of the cephalic and maxillipedal segments. From the middle of this vault a funnel-shaped pharynx leads into a very narrow oesophagus of some length, which opens into a large cavity which appears to function as a gizzard. This cavity is nearly rounded in transverse section, but slightly flattened from above downwards, especially behind, the width of the lumen being about one quarter

the depth of the head and more than a third of its breadth. In length, it considerably exceeds half the length of the head, the œsophagus opening into it rather in front of the middle of its length. It is lined throughout with chitine, and presents sundry toothed plates and hairs which subserve the trituration of food. Of these plates and hairs, the following are the most remarkable: from the anterior wall of the cavity, on either side of the middle line, projects a strong flattened plate somewhat narrowed at its origin from the wall of the cavity and expanded at its border, which latter is armed with a double row of strong teeth, very like those on the triturating plate of the mandible; the upper ranks of these teeth are short, strong, and somewhat lanceolate in form, while the lower ranks are longer, thinner, and of more uniform thickness, and interdigitate with a series of similar long weak teeth placed on a second pair of plates situated on the anterior portion of the ventral wall of the organ (Plate II, fig. 3.). Lastly, the middle part of the dorsal wall of the organ is densely clothed with long thin flexible hairs. From the vicinity of the posterior end of the ventral wall, rather nearer the posterior end of the organ than to the point of entry of the œsophagus, a funnel-shaped depression leads to a very short channel, which admits the food to a second chitined cavity, which I have already alluded to as the "sifting stomach." Seen in transverse section this latter cavity has a cordate outline; a strong chitinous ridge, with a very broad base, projecting upwards into its lumen from its ventral wall, and reaching upwards nearly to the level of the dorsal wall of the organ, thus dividing the greater part of the length of the cavity into two nearly distinct spaces. In front and behind, this ridge sinks down rapidly to the level of the ventral wall of the cavity. Each of the two main spaces into which the viscus is thus cut off is further subdivided by a very delicate chitinous plate which projects upwards and inwards nearly as high as the main median ridge. These plates, the median ridge, and the walls of the viscus are alike clothed with closely set, short, and stiff, but very fine, hairs, so that the entire organ must form a most efficient sieve by which all particles that have not been sufficiently comminuted in the gizzard are kept from entering the mid-gut. The "sifting stomach" opens behind by a constricted channel into the mid-gut. The mid-gut is of considerable dimensions, and is perfectly straight and of nearly uniform diameter throughout, it opens by a narrow anus on the under surface of the sixth abdominal segment close to the telson. In its anterior portion the endothelial coat is two cells in thickness and the mesoblastic layer of perceptible thickness. In the hinder part of the canal, however, the endothelium is reduced to a single row of cells and the meso-



blastic layer is so thin as to be scarcely perceptible. It is a simple rounded channel without foldings or complications of any sort. The large size of the canal is no doubt connected with the bulky nature of the food in proportion to its contained nutriment. In all but one of the specimens cut the intestinal canal was full and its contents simply mud, exactly similar to that clinging to the outside of the animal, which appears to live by swallowing the mud without any particular selection, trusting to the elaborate arrangements of its digestive apparatus to separate and utilize any particles that may possess a nutritive value.

*Glandular System.*—This in our species possesses but a feeble development. Situated below the main mass of the supra-oesophageal ganglion is the green gland, consisting of a mass of somewhat elongated cells enclosed in a distinct capsule. The situation of its duct could not be made out. The liver lies behind the gizzard and immediately underneath the anterior end of the dorsal vessel. It is of small size, and does not completely sheath the mid-gut, being placed almost entirely above and at the sides. Certain glandular cells can also be made out within the basipodites of certain of the thoracic appendages, notably of the fifth, but the position of their ducts could not be discovered with certainty, although I am inclined to think that the opening is in the propodite, near its articulation with the dactylopodite.

*Vascular System.*—The dorsal vessel is a tube of considerable size occupying the greater part of the space between the great extensor muscles of the segments above and the intestinal canal below; and is slightly constricted at the points of junction of segments. Of large size in the thoracic region, it tapers off, in front and behind, and is lost. Beyond the constrictions, already mentioned, no signs of valves could be made out. It appears to open by minute, oblique slits into the general lymph spaces surrounding it. In histological structure it consists of an inner layer of flat, polygonal epithelioid cells, covered by a layer of flattened nucleated fibres disposed in a regular spiral round the tube, the ostioles communicating with the lymph space consisting of interstices between the thus obliquely placed fibres (Pl. II, Fig. 3). The general body cavity is divided into lateral halves by a delicate vertical septum connecting the dorsal vessel with the body wall above and with the intestinal canal below, and each half is further subdivided by a horizontal septum running from pleuron to pleuron above the generative gland tubes to the side of the intestine.

*Organs of Respiration.*—The branchiæ of our species attain an exceptional degree of complexity. There are five pairs, which are attached to the coxopodite of each of the thoracic appendages except the

first and last. Each gill plate consists of a flattened lamina of considerable length, the longest being nearly as long as twice the depth of the body. From each face of this primary lamina, spring secondary laminæ arranged in regular alternation on either side to the number of 20 or 30 on each face. These secondary laminæ are of considerable area, the depth of the largest being quite half the length of an average thoracic segment. Gills of so complicated a structure as this are rare amongst the Amphipoda, and their presence in our species is no doubt connected with its mode of life. Burrowing as it does in thick mud, its anterior abdominal appendages cannot be kept in the usual rapid vibration which in most species maintains a free current of water through the subthoracic hollow. Such a current being unobtainable, the difficulty is met by the great increase of available gill surface secured by the complex branchial structure already described.

*Organs of Reproduction.*—Although a very large number of specimens was obtained, all appear to belong to the female sex, all presenting the same external characteristics, and all the specimens that were dissected having the same form of generative gland. Apparently the animals were not breeding at the time of the haul, as, although the ovaries of most of those sectionized contained young ova, none carried eggs beneath the thorax. The ovaries consist of a simple tube bent on itself and occupying nearly the entire length of the thorax, so that a typical section exhibits four tubes cut across and disposed in a semicircle below the alimentary canal; of these the outer pair appear to be the glandular and the inner, the duct portions of the organs. Such ova as were met with in this latter portion of the tube were enveloped in a voluminous ovoid coating of albuminous material. The flexure of the ovarian tube takes place at the anterior end of the thorax, so that its blind commencement is in the most posterior portion of the region. In one series of sections, the organ presents a suspicious resemblance to a sperm-producing gland, in other respects differing in no way from the usual type, while no ova could be made out in any portion of the series of sections. It may be that this is a male specimen, but, if this be the case, the organs of both sexes closely resemble each other, even to the detail of the double tube bent on itself.

### 3. MICRODEUTOPUS MEGNÆ, n. sp., Pl. VII., Figs. 1—4.

The species described below was taken in the surface net in the turbid water (about 6 fathoms) of the Megna Shoals.

The animal, which is  $4\frac{1}{2}$  mm. long, is of a dirty white colour, and the intestinal canal often shews through the body as a greenish streak.

The *head* is small and somewhat excavated below, the antennæ originating a good deal behind the antennules. There is no rostrum, and the single small black rounded eye is placed on a prominent angle situated between the antennules and antennæ.

The *thorax* forms a little more than half of the entire body length, and is long and slender, the segments (saving the first, which is shorter) being subequal. The coxal plates are small and narrow, the anterior ones being so short as not to overlap in all positions of the animal; that of the third is the deepest, while the last three are extremely narrow.

The *abdomen* is small and, like the thorax, narrow, its first three segments being about the same size and depth as the immediately preceding thoracic segments with their coxæ. The last three segments are small and nearly cylindrical, and the short *telson* is armed above with a pair of peculiar conical protuberances bearing a single strong bristle. The last three segments also have their posterior borders furnished, in the middle line, with a few short stiff hairs.

The *antennules* and *antennæ* are stout, approaching the pediform, especially in the case of the latter. They are subequal in length, the antennules being a little the longer, equalling the length of the thorax less its last segment. The peduncle of the *antennules* forms nearly two-thirds of the entire length of the organs and is very stout. It consists of three joints, of which the first is the stoutest, but is intermediate in length between the two remaining joints, the second joint being much the longest and forming nearly half the peduncle, while the last joint is the shortest and slenderest. All three joints are moderately hirsute, especially along their inferior borders. The appendage of the antennule is uni-articulate, and so small as to be very easily overlooked, indeed, it is of so delicate a character that it will be found to be wanting in a large proportion of specimens. The flagellum proper is very slender and consists of 10 to 14 short articuli armed with extremely short hairs.

The peduncle of the *antennæ* is both absolutely and relatively much longer and stouter than that of the antennules. It is five-jointed, the first two joints being short, but very stout, the last two very long and subequal to each other and to the long middle joint of the peduncle of the antennule, and the third joint about half the length of the two distal pieces. All its joints are moderately hirsute especially on the inferior borders, and the last joint is additionally armed on the sides with a number of stout tooth-like spines. The flagellum is very short, forming not a quarter of the entire length of the organs, and consists of 10 or 12 very short, feebly armed articuli.

The *gnathites* and the digestive apparatus generally present a strong general resemblance to those of *Ampelisca lepta*, already described. The

mandibles are of even more complex structure, their cutting and triturating plates being alike doubled. Each pair of plates is immovably connected together, the two cutters having simple toothless chisel edges and closely resembling each other in general form, while the triturating plates are very peculiar, the more superficial plate being smaller than the deeper and armed with short, stout, conical teeth, the most anterior being blunt and considerably longer than the rest, and the deeper triturating plates even more complex. Most anteriorly comes a vertically arranged row of three stout, bluntly conical teeth placed, it will be observed, at right angles to the main row of triturating processes. Behind this row comes a peculiar stout tooth with a trenchant bifid apex, and, behind this again, a number of long stout spines of no great strength. The mandibular appendage is of exceptionally great proportional size, being absolutely considerably longer than the pediform ramus of the maxilliped, and may often be made out projecting forwards between the roots of the antennules and antennæ. The palp has four joints, of which the first is very short, while the remaining three are subequal and long. The last joint ends in a dense brush of long thin hairs, but the remainder of the organ is nearly smooth.

The *digestive organs*, as far as they were examined, closely resemble those of *Ampelisca lepta*, the chitinous stomach being subdivided into two cavities, and closely resembling that of *Ampelisca* in the arrangement of its armature. There is the same pair of strongly armed plates at the anterior extremity of the organ, and it is further notable that, as in *Ampelisca*, the spines of these plates resemble in form those on the posterior portion of the triturating mandibular plate; being simple pointed rods, in both cases, in the present species; and lancet-headed spines in both situations in *Ampelisca*. The "sifting" stomach appears to be of identical construction in both species.

The second and third *thoracic appendages*, or *gnathopoda*, present considerable sexual differences. In the male, the 1st gnathopod, though of but medium length, is immensely stout, being nearly as thick as the body of the animal. It is furnished with a well-developed and very powerful double subchela, the dactylus, which is strong and a little varicose, but otherwise unarmed, being opposable to the nearly quadrangular, very short, and hirsute propodite and the latter again to the prolonged postero-inferior angle of the immensely dilated carpopodite. The articulation between this latter and the meropodite is very oblique, being placed much more on the anterior than on the inferior aspect of the articulus. The remaining joints, though very short, present nothing remarkable. The second gnathopod in the male is short, slender, and imperfectly subchelate, the dactylus being barely opposable to the dilated,

but not prolonged, propodite. As in its predecessor, the articulation between the carpus and merus is extremely oblique.

In the female, the *gnathopods* are both much smaller, the first, though larger, being not disproportionately so to the second. The subchelæ of both pairs are single and very rudimentary, that of the first being barely opposible and the grip secured only by a few weak spines on the propodite, while the second pair differ but little from an ordinary ambulatory appendage. The carpo-meropodital articulation of the first is oblique, but in the second gnathopod it is of the ordinary type.

In the young male, the 1st gnathopoda are comparatively small, but can still be distinguished from those of the female by the presence of the distally prolonged spine of the propodite.

The 4th and 5th *thoracic appendages* have rather long and falciform dactylopodites, but are otherwise of the usual ambulatory type; the fifth is the longer of the two, being as long as the last four thoracic segments and subequal to the sixth appendage, while the fourth, which is subequal to the third, is at least one-fifth shorter. The sixth, seventh, and eighth thoracic appendages resemble each other in general form, but increase in dimensions, especially in length, from before backwards, the increase being mainly in the great proportionate length of their distal articuli, the length of their basi- and ischiopodites differing in much smaller proportion, so that, while the sixth does not exceed the fifth in length, the seventh appendage is as long as the entire thorax, and the eighth longer than the seventh by the length of the animal's head. Their basipodites are much compressed, but not distinctly buttressed.

The first three *abdominal appendages* are large and powerful and well armed with hairs, and the last three, short and cylindrical with styloid rami, both protopodites and rami being armed with a number of short stout spines. When extended, they all three reach about the same level and their rami are subequal, the protopodite of the last pair being extremely short.

The animal was found in considerable numbers to all appearance swimming freely in the water; there was, however, abundant drift wood which may have served as its hiding place, and the little creatures when under observation showed a very strong tendency to take advantage of such opportunities of concealment.

It is possible that those taken had been washed from their hold by the strength of the current, which often reaches a speed of  $4\frac{1}{2}$  knots on the Megna Flats. Still, I cannot say that I actually detected a specimen burrowing a shelter for itself in any case that came under my observation.

The posterior appendages are, however, admirably adapted for clinging to any chance protection that might be met with.

The male is provided with five pairs of simple *branchial laminae* attached to each thoracic appendage between the third and seventh inclusive. In the female, the gravid egg pouch renders it difficult to make out the exact number of these laminae, but I am inclined to think that it is the same as in the male.

Our species differs from *M. gryllotalpa* in the much greater proportionate size of the 8th thoracic appendage; from *M. websterii* in the larger size of the seventh appendage and in the body of the latter being much stouter; from *M. anomalus* and *M. tenuis* in the appendage of the superior antenna being uni- instead of multi-articulate; from *M. versiculatus* in the posterior thoracic appendages being longer in that species, and in the peculiar form of the anterior thoracic appendages of *versiculatus*; from *M. longipes* in the antennules and antennae being subequal in our species, while in the former the antennule is much longer than the antenna; from *M. macronyx* in the three posterior segments of the pleon being armed with spines; from *M. grandimanus* in the antennules and antennae being nearly of equal length and in the form of the last pair of abdominal appendages, which in our species have the peduncle much shorter than, instead of subequal to, the rami; from *M. australis*, *M. tenuipes*, and *M. chelififer*, in the flagellum of the antennules being shorter instead of longer than the peduncle; and from *M. mortoni* in this same point (which appears to characterize all the Australian members of the genus), and in the form of the first gnathopod of the male; *M. maculatus* (Thompson, Am. N. 4, (5), IV, p. 33, from Dunedin, New Zealand), agrees with the other Australasian forms in possessing a very long antennule, the appendage of which is multi-articulate, and differs further from our species in the comparative shortness of the 7th thoracic appendage.

#### 4. MONOCULODES MEGAPLEON, n. sp., Pl. VII., Fig. 12.

This species was taken at the surface in the drift net in rather turbid water on the banks off Chittagong.

Only a single (probably male) specimen was obtained, so that I am unable to furnish any details as to its more minute anatomy. The animal is 3.2 mm. long, of a dirty white colour, and the intestinal canal shews through the carapace as a greenish streak.

The *head* is very small, and is produced in front into a peculiar, down-turned hooked rostrum, very minutely serrated along its posterior border. The anterior half of the upper surface, and a portion of the

sides, are occupied by the eyes, which blend in the middle line so as to appear to be a single organ.

The *thorax* is small, forming only a third of the whole body length. The segments increase gradually in length from before backwards, the last being nearly double the length of the first, and are of very moderate depth. The coxal plates, however, are very deep, nearly equalling, as a general rule, the depth of their corresponding segments. The last coxal plate is the only marked exception to this rule, being only half the depth of the corresponding segment and little more than half the depth of that immediately preceding it.

The *abdomen* is very large, forming more than half of the total body length, the first three segments alone exceeding the thorax in length, while the remaining three are as long as the first four thoracic segments. The first three segments are of great depth, while the last three are rather narrow. The *telson* is simple and laminar.

The *antennule* is slightly longer than the thorax. It is moderately hirsute, the distinction between peduncle and flagellum is very ill-marked, the first joint alone of the former markedly exceeding the succeeding articulations in size. The flagellum consists of 10 or 12 short joints.

The *antennæ* are slightly longer, exceeding the antennules by the length of an average thoracic segment. The peduncle forms a good deal less than half its length, is moderately hirsute, and consists of five joints, of which the first three are very short and the last two long and stouter than any part of the peduncle of the antennule. The flagellum is very smooth, its hairs being extremely fine and short, and consists of about forty very short joints, the lines between the component articuli being very indistinct.

With the exception of the maxilliped, which is small, hirsute, and clawed, nothing could be made out of the *gnathites*, which are very small and almost completely hidden by the sides of the head.

The second and third *thoracic appendages* are long and slender, the third being a little the longer and stouter, nearly equalling the combined head and thorax in length. They closely resemble each other and shew well the peculiar form characteristic of the genus in having the postero-inferior angle of the carpopodite prolonged into a spine opposite to the propodite and long enough to meet the dactylopodite. This spine in the second thoracic appendage projects a little behind the propodite, while in the third the propodite slightly exceeds the spine. The fourth and fifth are the shortest of the thoracic appendages; they are subequal and moderately stout, and closely resemble each other, both being very hirsute and termi-

nated by a brush of hairs so dense as to hide their dactylopodites, which, if present, must be very small. The sixth and seventh are stout, and alike in general form, having their meropodites considerably expanded. They are articulated quite to the edge of the coxæ and their basipodites, though strong, are without buttress plates. The seventh is considerably the longer, the sixth being only as long as the head and the first four thoracic segments, while the seventh is as long as the head and thorax save its last segment. The eighth is unfortunately partially wanting on both sides in my one specimen, but is evidently much the largest and longest of the appendages, the basi-, ischio-, and meropodites, which remain, being very considerably larger than those of any other appendage; the basipodite is strengthened by buttress-like plates both in front and behind.

The first three *abdominal appendages* are of the usual type, but are exceptionally powerful. The last three are rather long and thin, the fourth being longest, and the sixth the shortest, the fifth, however, projecting rather beyond the other two, when all three are extended. They are almost without hairs or spines, such as are present being very fine and short, and have their protopodites cylindrical and their rami, of which each has a pair, of styloid form.

Our species differs from *M. carinatus* in wanting the dorsal keels and in both gnathopoda being of typical form; from *M. stimpsonii* in the much larger proportional size of the abdomen; and from *M. demissus* in the last two coxæ being of fair size, certainly not very small, in the eyes being black and not vermilion-coloured, and in the greater size of the abdomen.

#### CONCHOLESTES, gen. nov.

The following species is a most singular one in its habits. It belongs certainly to the subfamily *Corophiides* of the family *Corophiidae*, but I can find no genus, either in Spence Bate's Catalogue of the British Museum Amphipoda, or amongst the numerous new genera that have been established in the family since the date of that publication, that, by any moderate extension, can be made to include so peculiar a species, although it certainly approaches most nearly to *Corophium*.

It was obtained by dredging in 7 fathoms, on a sandy bottom, off the "Seven Pagodas," on the Madras Coast. Amongst the catch were a number of specimens of *Dentalium lacteum*, some living, a few empty, and more containing a small pagurus. On examining the latter, I was surprised to find that two specimens were inhabited by a tubicolous amphipod which had made its home in the shell, lining it with a mix-



ture of silken secretion with fine sandy particles; this inner tube being quite distinct and coherent when separated from the shell by dissolving the latter in dilute hydrochloric acid.

Though quite lively, it was evident that the animal must be quite confined to the bottom, as it was evidently incapable of lifting its heavy house, but crawled about the bottom of the jar by means of its powerful antennæ. Of the two specimens, one was a female, and it is noticeable that the eggs she carried were enclosed in no proper egg-pouch, but were retained under the thorax only by narrow plates fringed with long hairs, which, though of equal morphological value, differ markedly from the usual broad plates.

So far as I am aware, the circumstance of an amphipod making use of a deserted shell as a tube has not been previously observed, and I have based the proposed generic name on this circumstance.

Animal long and slender, with the abdomen composed of six distinct but very small segments; antennule moderately large, flagellate, but without appendage; antennæ very large and pediform inserted barely behind the antennules; 3rd thoracic appendage with a well-developed subchela considerably larger than the weakly subchelæ of 2nd thoracic appendage; 7th and 8th thoracic appendages short, with the carpopodital articulation peculiarly modified, the joint being placed obliquely on the anterior and outer face of the articulus, and the distal end of the carpopodite rounded, and covered with short closely set recurved hooklets; 8th thoracic appendage ambulatory; 4th abdominal appendage biramous, 6th blunt, rounded, without rami, nearly hidden beneath the squamous telson.

##### 5. *CONCHOLESTES DENTALII*, n. sp., Pl. VII, Figs. 7—11.

The *head*, seen laterally, forms a truncated pyramid with the base forwards, the small eye being situated on a small angular process between the antennule and antenna, but no marked recess is formed for the reception of the latter appendage. The carapace projects forwards a little in the middle line between the antennæ in the form of two processes, forming a sort of bifid rostrum.

The *thorax* is very large, being a little more than twice as long as the combined head and abdomen. The length of the segments is somewhat irregular, the first being the shortest, the 2nd, 5th, and 6th subequal and longest, and the remaining segments of intermediate length. The first segment has the additional peculiarity of being prolonged into a sort of rostrum, armed with a tuft of hairs, which overlaps the back of the head. The coxal plates are small,

and quite distinct from each other, the first four forming conical processes directed obliquely forwards and downwards from their corresponding pleura, and the hinder three being longer, but very narrow, plates.

The first three *abdominal segments* are subequal, nearly cylindrical, and are a little shorter than the first thoracic segment; the last three are very diminutive, and the *telson* short, squamous, and semilunar.

The *antennule* is stout, less than half as long as the body. Its peduncle forms three-fourths of the length of the organ, and consists of three joints, subequal in length, but diminishing progressively in stoutness, and the flagellum consists of five stout longish articuli. Both peduncle and flagellum are armed with a large number of long stiff hairs, and the flagellum is, in addition, provided below with a series of flexible flattened hairs quite different from the others. The antenna is pediform and much the largest of all the appendages, being very stout and nearly as long as the entire thorax. Almost the entire length of the organ is formed by the peduncle, the flagellum being represented by a single short, stout joint terminated by a pair of strong claws. The first and last peduncular articuli are subequal and rather short, the second a little longer than these, and the third and fourth subequal and very long, forming together two-thirds of the length of the organ, which is profusely armed with long, stiff hairs.

The *gnathites*, as far as they could be examined, present no points of peculiar interest, the mandibles being of simple form and palpate, and the maxillipeds small and unguiculate.

The first of the *gnathopods* is but feebly subchelate, no palm being developed to the propodite; such grasping power as it may have being furnished by a number of fine serrations on the dactylopodite and some stiffish hairs on the protopodite. The appendage is as long as the peduncle of the superior antennæ; the second gnathopod, though but little longer, is much stouter and has the protopodite much dilated, the palm, though rather oblique, being strongly armed with three formidable teeth, and the dactylopodite being strongly serrated. The dactylopodite also presents the following additional peculiarities: first, it is armed in its anterior border with one or two hairs, a most exceptional circumstance, and, secondly, it is really trifold when seen from above, as, from a point about half way along its length, a powerful secondary tooth projects obliquely on either side; these latter being but little exceeded by the main central tooth either in length or stoutness. As in the 1st gnathopod, the carpo-propodital articulation is rather oblique.

The next two *thoracic appendages* (4th and 5th) are short, being only as long as the two first joints of the peduncles of the anten-

nules. They are mainly remarkable for the stoutness of their articuli and the length and straightness of their dactylopodites. The 6th and 7th thoracic appendages are of very peculiar structure, and have already been shortly described in the generic diagnosis. They are similar in general form, but the 6th is somewhat the larger, its excess of length being gained mainly in the basipodite. Each carpopodite forms a stout cylinder, armed at its point with a short, stout spine, and densely clothed at its apex and outer aspect with short stout recurved hooks. The propodite is articulated a little below the middle of the outer and anterior aspect of the carpopodite, and the dactylopodite forms a small, but much curved hook. The 8th thoracic appendage differs considerably from any of the other appendages, and is more of the normal type. Subequal to the second gnathopod in length, it is the slenderest of all the appendages, the basipodite alone being of any size, and even this considerably tapered distally. All the thoracic appendages are somewhat hirsute.

The first three *abdominal appendages*, though of the usual type, are very small and much broader than long. The fourth is the largest of them all, its peduncle being stout and armed with a few stout spines, and its rami, which are equally stout, about half the length of the peduncle and armed with a number of stiff slightly curved spines. The articulations of the rami of this appendage with its peduncle are strong and of hinge type; and watching the animal while alive, I was impressed with the idea that the organ could be, and probably is, employed by the animal as a forceps for holding on to its house. Of the fifth abdominal appendage I have been unable to obtain a satisfactory view. It is small and its peduncle is very short, though of considerable breadth. The ramus appears to be single and rounded, and has its end beset with recurved hooks, similar to those on the carpopodites of the 6th and 7th thoracic appendages. The last abdominal appendage is short and blunt and has no ramus, its end being armed with a few spines, some of which show a tendency to hooking.

#### 6. AMPHITHOE INDICA, M.-Edw., Pl. X., Figs. 1—7.

This very beautifully ornamented species was obtained in the drift net, in the middle of the Bay of Bengal, on a voyage from Chittagong to Madras. Although so far from land, there was a certain amount of flotsom and jetsom to be met with on the surface, and it was in the interstices of such pieces that the little animal had its home. It builds no regular tube, but constructs an irregular sort of shelter for itself by glueing together tiny morsels of driftage, ekeing out its materials; from the appearance of some of the irregular masses resulting from its

architectural efforts, I am inclined to believe, with pellets of its own excreta, as observed in certain kindred species by F. S. Smith (*Nature*, 1880, p. 595). To this queer home it clings most tenaciously, and I should certainly have overlooked it altogether had not my assistant, in lifting some of the morsels of débris, with the view of cleaning the catch, accidentally demolished a homestead and evicted one of the tenantry; when a closer examination resulted in the discovery of a considerable number of specimens.

The animal is about 5 mm. long, and is very beautifully coloured. The ground colour is a rich deep purple, fading to nearly a burnt-sienna tint towards the dorsal line, the coxal plates being darkest and free from paler markings. The whole of the head and thorax is mottled with patches of the brightest golden yellow, which forms a broad, but somewhat irregular, band along the middle of the back, and is further disposed in irregular patches over the pleura of the somites. The basipodites of the thoracic appendages are of the deepest purple, but on their distal articuli the colour fades to a paler shade of the same tint.

The *head* has an irregularly pentagonal outline, its anterior border being peculiarly vertical and straight, and without any rostrum. It nearly equals in length the first two thoracic segments; its depth is but little less. The eye, which is coloured the brightest scarlet, is of medium size and placed at the antero-inferior angle of the head.

The *thorax* is large, forming five-ninths of the entire body length. Its segments are stout, and as deep as they are long, and do not differ markedly from each other in length, but the 3rd, 4th, 5th, and 6th are subequal, and about  $\frac{1}{3}$  longer than the two first and the last segments. The five anterior coxal plates are deeper than the corresponding segments, and the 5th has the additional peculiarity of being composed of two lobes, of which the anterior is as deep as, or deeper than, the coxæ in front of it, while the posterior lobe is very narrow and corresponds in form and depth to the very small coxæ of the 6th and 7th segments behind it.

The *abdomen* is small, forming but little more than  $\frac{1}{3}$ rd of the entire body length. Its first, second, and fourth segments are subequal in length to the first two thoracic segments, while the third is subequal to a median thoracic, and the last two are very short, the penultimate segment being the shortest of all. In depth, the 1st abdominal segment only equals the last thoracic segment and its coxæ, the 2nd and 3rd are somewhat deeper, and the last three segments very narrow. The *telson* is small, laminar, somewhat upturned, and of a roundedly conical outline. The last three segments are armed with a few hairs along the middle line.